

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	9	compromis\$5 and "leaf node" and "internal node" and key\$1 and leaf adj2 node\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:35
L2	43	compromis\$5 and ("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:29
L3	10	compromis\$5 and ("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:34
L4	13	compromis\$5 same (leaf or node\$) and ("leaf node" or leaf adj2 node\$1) and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:29
L5	2084	707/200.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:35
L6	0	5 and "leaf node" same hierarch\$6 same position	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:00
L7	19	5 and "leaf node" and hierarch\$6 and position\$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:48
L8	7	7 and "root node"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:48
L9	5	5 and "leaf node" with key\$1 and child near node\$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:33
L10	14	leaf near node same key and level adj defin\$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:04
L11	24	"leaf node" and "internal node" and key\$1 and leaf adj2 node\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:29
L12	168	("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:29

L13	474	(leaf or node\$) and ("leaf node" or leaf adj2 node\$1) and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:30
L14	180	13 and "leaf node" and position\$1 and path\$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:33
L15	107	14 and hierarch\$6	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:33
L16	13	15 and "leaf node" with key\$1 and child near node\$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:34
L17	36	defin\$5 same path\$1 same "leaf node" same "root node" and key\$1 and leaf adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:37

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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L2	43	compromis\$5 and ("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:29
L3	10	compromis\$5 and ("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:34
L4	13	compromis\$5 same (leaf or node\$) and ("leaf node" or leaf adj2 node\$1) and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:29
L5	2084	707/200.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:35
L6	0	5 and "leaf node" same hierarch\$6 same position	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:00
L7	19	5 and "leaf node" and hierarch\$6 and position\$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:48
L8	7	7 and "root node"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:48
L9	5	5 and "leaf node" with key\$1 and child near node\$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:33
L10	14	leaf near node same key and level adj defin\$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:04
L11	24	"leaf node" and "internal node" and key\$1 and leaf adj2 node\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:29
L12	168	("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:29

L13	474	(leaf or node\$) and ("leaf node" or leaf adj2 node\$1) and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:30
L14	180	13 and "leaf node" and position\$1 and path\$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:33
L15	107	14 and hierarch\$6	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:33
L16	13	15 and "leaf node" with key\$1 and child near node\$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:34
L17	36	defin\$5 same path\$1 same "leaf node" same "root node" and key\$1 and leaf adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 12:37
S1	1636	707/200.ccls.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:35
S2	0	compromis\$5 same "leaf node" and "internal node" and key\$1 and leaf adj2 node\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2004/06/23 19:57
S3	9	compromis\$5 and "leaf node" and "internal node" and key\$1 and leaf adj2 node\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:34
S4	0	compromis\$5 same ("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2004/06/24 16:39
S5	39	compromis\$5 and ("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:34
S6	0	compromis\$5 and ("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2004/06/25 10:41
S7	10	compromis\$5 and ("leaf node" or leaf adj2 node\$1) and key\$1 and encrypt\$4 and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:34

S8	10	compromis\$5 same (leaf or node\$) and ("leaf node" or leaf adj2 node\$1) and key\$1 and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2004/06/25 11:48
S9	12	compromis\$5 same (leaf or node\$) and ("leaf node" or leaf adj2 node\$1) and internal adj2 node\$1 and @ad<"20011214"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2005/09/28 11:35

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Relevance scale **1 [Extending object-oriented systems with roles](#)**

Georg Gottlob, Michael Schrefl, Brigitte Röck

July 1996 **ACM Transactions on Information Systems (TOIS)**, Volume 14 Issue 3Full text available:  [pdf\(610.03 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

In many class-based object-oriented systems the association between an instance and a class is exclusive and permanent. Therefore these systems have serious difficulties in representing objects taking on different roles over time. Such objects must be reclassified any time they evolve (e.g., if a person becomes a student and later an employee). Class hierarchies must be planned carefully and may grow exponentially if entities may take on several independent roles. The problem is even more ...

2 [Index-driven similarity search in metric spaces](#)

Gisli R. Hjaltason, Hanan Samet

December 2003 **ACM Transactions on Database Systems (TODS)**, Volume 28 Issue 4Full text available:  [pdf\(650.64 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Similarity search is a very important operation in multimedia databases and other database applications involving complex objects, and involves finding objects in a data set S similar to a query object q , based on some similarity measure. In this article, we focus on methods for similarity search that make the general assumption that similarity is represented with a distance metric d . Existing methods for handling similarity search in this setting typically fall into one of ...

Keywords: Hierarchical metric data structures, distance-based indexing, nearest neighbor queries, range queries, ranking, similarity searching

3 [Structured hypertext with domain semantics](#)

Weigang Wang, Roy Rada

October 1998 **ACM Transactions on Information Systems (TOIS)**, Volume 16 Issue 4Full text available:  [pdf\(593.99 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

One important facet of current hypertext research involves using knowledge-based techniques to develop and maintain document structures. A semantic net is one such

technique. However, most semantic-net-based hypertext systems leave the linking consistency of the net to individual users. Users without guidance may accidentally introduce structural and relational inconsistencies in the semantic nets. The relational inconsistency hinders the creation of domain information models. The structura ...

Keywords: graph theory, hypertext models, hypertext structures

4 [A comparison of application-level and router-assisted hierarchical schemes for reliable multicast](#) 

Pavlin Radoslavov, Christos Papadopoulos, Ramesh Govindan, Deborah Estrin
June 2004 **IEEE/ACM Transactions on Networking (TON)**, Volume 12 Issue 3

Full text available:  [pdf\(725.81 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

One approach to achieving scalability in reliable multicast is to use a hierarchy. A hierarchy can be established at the application level, or by using router-assist. With router-assist we have more fine-grain control over the placement of error-recovery functionality, therefore, a hierarchy produced by assistance from the routers is expected to have better performance. In this paper, we test this hypothesis by comparing two schemes, one that uses an application-level hierarchy (ALH) and another ...

Keywords: reliable multicast, router-assist for reliable multicast

5 [Hierarchical packet fair queueing algorithms](#) 

Jon C. R. Bennett, Hui Zhang
October 1997 **IEEE/ACM Transactions on Networking (TON)**, Volume 5 Issue 5

Full text available:  [pdf\(455.41 KB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#), [review](#)

Keywords: hierarchical packet scheduling, link-sharing, quality of service, real-time, resource management

6 [A nested transaction model for multilevel secure database management systems](#) 

Elisa Bertino, Barbara Catania, Elena Ferrari
November 2001 **ACM Transactions on Information and System Security (TISSEC)**, Volume 4 Issue 4

Full text available:  [pdf\(560.96 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This article presents an approach to concurrency control for transactions in a Multilevel Secure Database Management System (MLS/DBMS). The major problem is that concurrency control mechanisms used in traditional DBMSs are not adequate in a MLS/DBMS, since they may be exploited to establish covert channels. The approach presented in this article, which uses single-version data items, is based on the use of nested transactions, application-level recovery, and notification-based locking protocols. ...

Keywords: Nested transactions, concurrency control, covert channels, multilevel secure database management systems

7 [Exploiting hierarchical domain structure to compute similarity](#) 

Prasanna Ganesan, Hector Garcia-Molina, Jennifer Widom
January 2003 **ACM Transactions on Information Systems (TOIS)**, Volume 21 Issue 1

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index](#)

Full text available:  [pdf\(285.80 KB\)](#)[terms](#)

The notion of similarity between objects finds use in many contexts, for example, in search engines, collaborative filtering, and clustering. Objects being compared often are modeled as sets, with their similarity traditionally determined based on set intersection. Intersection-based measures do not accurately capture similarity in certain domains, such as when the data is sparse or when there are known relationships between items within sets. We propose new measures that exploit a hierarchical ...

Keywords: Similarity measures, collaborative filtering, data mining, hierarchy

8 Dynamic control of performance monitoring on large scale parallel systems 

Jeffrey K. Hollingsworth, Barton P. Miller

August 1993 **Proceedings of the 7th international conference on Supercomputing**Full text available:  [pdf\(1.24 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index](#)
[terms](#)

Performance monitoring of large scale parallel computers creates a dilemma: we need to collect detailed information to find performance bottlenecks, yet collecting all this data can introduce serious data collection bottlenecks. At the same time, users are being inundated with volumes of complex graphs and tables that require a performance expert to interpret. We present a new approach called the W3 Search Model, that addresses both these problems by combining dynamic o ...

9 Visualization: Query, analysis, and visualization of hierarchically structured data using Polaris 

Chris Stolte, Diane Tang, Pat Hanrahan

July 2002 **Proceedings of the eighth ACM SIGKDD international conference on Knowledge discovery and data mining**Full text available:  [pdf\(10.02 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index](#)
[terms](#)

In the last several years, large OLAP databases have become common in a variety of applications such as corporate data warehouses and scientific computing. To support interactive analysis, many of these databases are augmented with hierarchical structures that provide meaningful levels of abstraction that can be leveraged by both the computer and analyst. This hierarchical structure generates many challenges and opportunities in the design of systems for the query, analysis, and visualization of ...

10 Hierarchical planarity testing algorithms 

Thomas Lengauer

July 1989 **Journal of the ACM (JACM)**, Volume 36 Issue 3Full text available:  [pdf\(2.55 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index](#)
[terms](#), [review](#)

Using hierarchical definitions, one can describe very large graphs in small space. The blow-up from the length of the hierarchical description to the size of the graph can be as large as exponential. If the efficiency of graph algorithms is measured in terms of the length of the hierarchical description rather than in terms of the graph size, algorithms that do not exploit the hierarchy become hopelessly inefficient. Whether the hierarchy can be exploited to speed up the solution of graph p ...

11 Creating generative models from range images 

Ravi Ramamoorthi, James Arvo

July 1999 **Proceedings of the 26th annual conference on Computer graphics and interactive techniques**

Full text available:  pdf(8.54 MB)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)**Keywords:** curves and surfaces, generative models, procedural modeling, range images**12 Structural analysis of hypertexts: identifying hierarchies and useful metrics** 

Rodrigo A. Botafoogo, Ehud Rivlin, Ben Shneiderman

April 1992 **ACM Transactions on Information Systems (TOIS)**, Volume 10 Issue 2Full text available:  pdf(2.24 MB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Hypertext users often suffer from the "lost in hyperspace" problem: disorientation from too many jumps while traversing a complex network. One solution to this problem is improved authoring to create more comprehensible structures. This paper proposes several authoring tools, based on hypertext structure analysis. In many hypertext systems authors are encouraged to create hierarchical structures, but when writing, the hierarchy is lost because of the inclusion of cros ...

Keywords: graph theory, hierarchies, hypertext, metrics, structural analysis**13 SaveMe: a system for archiving electronic documents using messaging groupware** 

Stefan Berchtold, Alexandros Biliris, Euthimios Panagos

March 1999 **ACM SIGSOFT Software Engineering Notes, Proceedings of the international joint conference on Work activities coordination and collaboration**, Volume 24 Issue 2Full text available:  pdf(1.47 MB)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Today, organizations deal with an ever-increasing number of documents that have to be archived because they are either related to their core business (e.g., product designs) or needed to meet corporate or legal retention requirements (e.g., voucher). In this paper, we present the architecture and prototype implementation of SaveMe, a document archival system that is based on network-centric groupware such as Internet standards-based messaging systems. In SaveMe, the actions of archiving, retriev ...

Keywords: Internet, archiving, groupware, messaging**14 What makes a good user interface pattern language?** 

E. Todd, E. Kemp, C. Phillips

January 2004 **Proceedings of the fifth conference on Australasian user interface - Volume 28 CRPIT '04**Full text available:  pdf(502.58 KB)Additional Information: [full citation](#), [abstract](#), [references](#)

A developer of user interfaces (UI) should be able to employ a user interface pattern language to design acceptable user interfaces. But, what makes a good pattern language? Three types of validation were identified as requiring consideration: the validity of the individual patterns, the internal validation of the pattern language and the external validation of the pattern language. This paper investigates internal validity. A set of six tests that a developer can use to test the internal validi ...

Keywords: pattern language validation, pattern languages, user interface design**15 A survey of Web metrics** 

Devanshu Dhyani, Wee Keong Ng, Sourav S. Bhowmick
 December 2002 **ACM Computing Surveys (CSUR)**, Volume 34 Issue 4

Full text available:  [pdf\(289.28 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The unabated growth and increasing significance of the World Wide Web has resulted in a flurry of research activity to improve its capacity for serving information more effectively. But at the heart of these efforts lie implicit assumptions about "quality" and "usefulness" of Web resources and services. This observation points towards measurements and models that quantify various attributes of web sites. The science of measuring all aspects of information, especially its storage and retrieval or ...

Keywords: Information theoretic, PageRank, Web graph, Web metrics, Web page similarity, quality metrics

16 Default representation in constraint-based frameworks

Alex Lascarides, Ann Copestake

March 1999 **Computational Linguistics**, Volume 25 Issue 1

Full text available:

 [pdf\(3.17 MB\)](#) 

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Default unification has been used in several linguistic applications. Most of them have utilized defaults at a metalevel, as part of an extended description language. We propose that allowing default unification to be a fully integrated part of a typed feature structure system requires default unification to be a binary, order independent function, so that it acquires the perspicuity and declarativity familiar from normal unification-based frameworks. Furthermore, in order to respect the behavio ...

17 Implementing the product automation formalism

Frederick J. Portier

December 1987 **Proceedings of the 19th conference on Winter simulation**

Full text available:

 [pdf\(842.97 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)



A formalism for discrete simulation is a set of conventions for the construction of discrete simulation models. In this paper we define the product automaton formalism. The formalism is defined as a mathematical object and is independent of any programming language. Implementing the formalism in a specific programming language entails associating the various components of the formalism with language constructs. We show how the formalism can be implemented in any procedural language. Further ...

18 Conceptual learning in database design

Yannis E. Ioannidis, Tomas Saulys, Andrew J. Whitsitt

July 1992 **ACM Transactions on Information Systems (TOIS)**, Volume 10 Issue 3

Full text available:

 [pdf\(2.00 MB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)



This paper examines the idea of incorporating machine learning algorithms into a database system for monitoring its stream of incoming queries and generating hierarchies with the most important concepts expressed in those queries. The goal is for these hierarchies to provide valuable input to the database administrator for dynamically modifying the physical and external schemas of a database for improved system performance and user productivity. The criteria for choosing the appropriate lea ...

Keywords: /UNIMEM, COBWEB, adaptive database systems, learning from examples

19 Employing hierarchical federation communities in the virtual ship architecture

Anthony Cramp, Michael Oudshoorn

January 2002 **Australian Computer Science Communications , Proceedings of the twenty-fifth Australasian conference on Computer science - Volume 4 CRPITS '02**, Volume 24 Issue 1Full text available: [pdf\(838.26 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper discusses work underway to develop a framework for the use of hierarchical federation communities as a tool for distributed simulation. The Virtual Ship Project is the application driving the development of the framework. The specific problem within the Virtual Ship Project is one of having to filter unwanted data. It is expected that a hierarchical federation community structure will implicitly provide the necessary data filtering. There are two main goals in establishing hierarchical ...

Keywords: HLA, federation communities, federations of federations, hierarchical federations, virtual ship

20 Cryptographic tools: ID-based encryption for complex hierarchies with applications to forward security and broadcast encryption

Danfeng Yao, Nelly Fazio, Yevgeniy Dodis, Anna Lysyanskaya

October 2004 **Proceedings of the 11th ACM conference on Computer and communications security**Full text available: [pdf\(220.00 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

A forward-secure encryption scheme protects secret keys from exposure by evolving the keys with time. Forward security has several unique requirements in hierarchical identity-based encryption (HIBE) scheme: (1) users join dynamically; (2) encryption is joining-time-oblivious; (3) users evolve secret keys autonomously.

We present a scalable forward-secure HIBE (fs-HIBE) scheme satisfying the above properties. We also show how our fs-HIBE scheme can be used to construct a forward-secure ...

Keywords: ID-Based encryption, broadcast encryption, forward security

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1 The complexity of XPath query evaluation and XML typing 
Georg Gottlob, Christoph Koch, Reinhard Pichler, Luc Segoufin
March 2005 **Journal of the ACM (JACM)**, Volume 52 Issue 2

Full text available:  pdf(447.53 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We study the complexity of two central XML processing problems. The first is XPath 1.0 query processing, which has been shown to be in PTIME in previous work. We prove that both the data complexity and the query complexity of XPath 1.0 fall into lower (highly parallelizable) complexity classes, while the combined complexity is PTIME-hard. Subsequently, we study the sources of this hardness and identify a large and practically important fragment of XPath 1.0 for which the combined complexity is L ...

Keywords: Complexity, DTD, LOGCFL, XML, XPath

2 A needed narrowing strategy 
Sergio Antoy, Rachid Echahed, Michael Hanus
July 2000 **Journal of the ACM (JACM)**, Volume 47 Issue 4

Full text available:  pdf(336.29 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The narrowing relation over terms constitutes the basis of the most important operational semantics of languages that integrate functional and logic programming paradigms. It also plays an important role in the definition of some algorithms of unification modulo equational theories that are defined by confluent term rewriting systems. Due to the inefficiency of simple narrowing, many refined narrowing strategies have been proposed in the last decade. This paper presents a new narrowing stra ...

Keywords: call-by-need, functional logic programming languages, narrowing strategies, rewrite systems

3 The Quadtree and Related Hierarchical Data Structures 
Hanen Samet
June 1984 **ACM Computing Surveys (CSUR)**, Volume 16 Issue 2

Full text available:  pdf(4.87 MB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

4 Optimal evaluation of array expressions on massively parallel machines 

Siddhartha Chatterjee, John R. Gilbert, Robert Schreiber, Shang-Hua Teng

January 1995 **ACM Transactions on Programming Languages and Systems (TOPLAS)**,

Volume 17 Issue 1

Full text available:  [pdf\(2.18 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We investigate the problem of evaluating Fortran 90-style array expressions on massively parallel distributed-memory machines. On such a machine, an elementwise operation can be performed in constant time for arrays whose corresponding elements are in the same processor. If the arrays are not aligned in this manner, the cost of aligning them is part of the cost of evaluating the expression tree. The choice of where to perform the operation then affects this cost. We describe the c ...

Keywords: Fortran 90, array alignment, compact dynamic programming, data-parallel programming, distributed memory parallel processors, fixed topology Steiner tree

5 Geometric compression through topological surgery 

Gabriel Taubin, Jarek Rossignac

April 1998 **ACM Transactions on Graphics (TOG)**, Volume 17 Issue 2Full text available:  [pdf\(8.98 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The abundance and importance of complex 3-D data bases in major industry segments, the affordability of interactive 3-D rendering for office and consumer use, and the exploitation of the Internet to distribute and share 3-D data have intensified the need for an effective 3-D geometric compression technique that would significantly reduce the time required to transmit 3-D models over digital communication channels, and the amount of memory or disk space required to store the models. Because ...

Keywords: 3D mesh compression, VRML, geometry compression

6 Session 4B: Algorithms for combining rooted triplets into a galled phylogenetic network 

Jesper Jansson, Nguyen Bao Nguyen, Wing-Kin Sung

January 2005 **Proceedings of the sixteenth annual ACM-SIAM symposium on Discrete algorithms**Full text available:  [pdf\(1.06 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#)

This paper considers the problem of determining whether a given set T of rooted triplets can be merged without conflicts into a galled phylogenetic network, and if so, constructing such a network. When the input T is dense, we solve the problem in $O(|T|)$ time, which is optimal since the size of the input is $\Theta(|T|)$. In comparison, the previously fastest algorithm for this problem runs in $O(|T|^2)$ time. Next, we prove that the problem ...

7 Modular stratification and magic sets for Datalog programs with negation 

Kenneth A. Ross

November 1994 **Journal of the ACM (JACM)**, Volume 41 Issue 6Full text available:  [pdf\(3.60 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

A class of “modularly stratified” logic programs is defined. Modular stratification generalizes stratification and local stratification, while allowing programs that are not expressible as stratified programs. For modularly stratified programs, the well-founded semantics coincides with the stable model semantics and makes every ground literal true or false.

Modularly stratified programs are weakly stratified, but the converse is false. Unlike some weakly stratified programs, mod ...

Keywords: deductive databases, magic sets, modular stratification, rule rewriting, stratification, well-sounded semantics

8 [Typing and querying XML documents: some complexity bounds](#)

Luc Segoufin

June 2003 **Proceedings of the twenty-second ACM SIGMOD-SIGACT-SIGART symposium on Principles of database systems**

Full text available:  [pdf\(246.23 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We study the complexity bound of validating XML documents, viewed as labeled unranked ordered trees, against various typing systems like DTDs, XML schemas, tree automata ... We also consider query evaluation complexities for various fragments of XPath. For both problems, validation and query evaluation, we consider data and combined complexity bounds.

9 [The string B-tree: a new data structure for string search in external memory and its applications](#)

Paolo Ferragina, Roberto Grossi

March 1999 **Journal of the ACM (JACM)**, Volume 46 Issue 2

Full text available:  [pdf\(363.37 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We introduce a new text-indexing data structure, the String B-Tree, that can be seen as a link between some traditional external-memory and string-matching data structures. In a short phrase, it is a combination of B-trees and Patricia tries for internal-node indices that is made more effective by adding extra pointers to speed up search and update operations. Consequently, the String B-Tree overcomes the theoretical limitations of inverted files, B-trees, prefix B-trees, s ...

Keywords: B-tree, Patricia trie, external-memory data structure, prefix and range search, string searching and sorting, suffix array, suffix tree, text index

10 [Optimal tree layout \(Preliminary Version\)](#)

Michael J. Fischer, Michael S. Paterson

April 1980 **Proceedings of the twelfth annual ACM symposium on Theory of computing**

Full text available:  [pdf\(747.81 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We consider the problem of finding a minimal cost layout of a tree in Euclidian d-space. A tree is an acyclic undirected edge-weighted graph, and a layout is an assignment of a point in d-dimensional Euclidian space to each of the nodes of the tree. The "length" of an edge in the layout is the "distance" between its endpoints as measured by some norm. The cost of an edge is its length times its weight ...

11 [A compressed accessibility map for XML](#)

Ting Yu, Divesh Srivastava, Laks V. S. Lakshmanan, H. V. Jagadish

June 2004 **ACM Transactions on Database Systems (TODS)**, Volume 29 Issue 2

Full text available:  [pdf\(528.00 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

XML is the undisputed standard for data representation and exchange. As companies transact business over the Internet, letting authorized customers directly access, and even

modify, XML data offers many advantages in terms of cost, accuracy, and timeliness. Given the complex business relationships between companies, and the sensitive nature of information, access must be provided selectively, using sophisticated access control specifications. Using the specification directly to determine if a user ...

Keywords: Access control, XML, structural locality

12 Index-driven similarity search in metric spaces



Gisli R. Hjaltason, Hanan Samet

December 2003 **ACM Transactions on Database Systems (TODS)**, Volume 28 Issue 4

Full text available: [pdf\(650.64 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Similarity search is a very important operation in multimedia databases and other database applications involving complex objects, and involves finding objects in a data set S similar to a query object q , based on some similarity measure. In this article, we focus on methods for similarity search that make the general assumption that similarity is represented with a distance metric d . Existing methods for handling similarity search in this setting typically fall into one of ...

Keywords: Hierarchical metric data structures, distance-based indexing, nearest neighbor queries, range queries, ranking, similarity searching

13 Necessary and sufficient conditions to linearize doubly recursive programs in logic databases



Weining Zhang, Clement T. Yu, Daniel Troy

September 1990 **ACM Transactions on Database Systems (TODS)**, Volume 15 Issue 3

Full text available: [pdf\(1.90 MB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

Linearization of nonlinear recursive programs is an important issue in logic databases for both practical and theoretical reasons. If a nonlinear recursive program can be transformed into an equivalent linear recursive program, then it may be computed more efficiently than when the transformation is not possible. We provide a set of necessary and sufficient conditions for a simple doubly recursive program to be equivalent to a simple linear recursive program. The necessary and sufficient conditions ...

Keywords: logic database

14 The hB $\$^\wedge \backslash \text{Pi} \$$ -tree: a multi-attribute index supporting concurrency, recovery and node consolidation



Georgios Evangelidis, David Lomet, Betty Salzberg

February 1997 **The VLDB Journal — The International Journal on Very Large Data Bases**, Volume 6 Issue 1

Full text available: [pdf\(314.15 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)

We propose a new multi-attribute index. Our approach combines the hB-tree, a multi-attribute index, and the $\$^\wedge \backslash \text{Pi} \$$ -tree, an abstract index which offers efficient concurrency and recovery methods. We call the resulting method the hB $\$^\wedge \backslash \text{Pi} \$$ -tree. We describe several versions of the hB $\$^\wedge \backslash \text{Pi} \$$ -tree, each using a different node-splitting and index-term-posting algorithm. We also describe a new node deletion algorithm. We have implemented all the versions of the hB $\$^\wedge \backslash \text{Pi} \$$ -tree. Our performance results ...

Keywords: Concurrency, Multi-attribute index, Node consolidation, Recovery

15 A model parametric real-time logic

Angelo Morzenti, Dino Mandrioli, Carlo Ghezzi

October 1992 **ACM Transactions on Programming Languages and Systems (TOPLAS)**,
Volume 14 Issue 4Full text available:  [pdf\(3.54 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

TRIO is a formal notation for the logic-based specification of real-time systems. In this paper the language and its straightforward model-theoretic semantics are briefly summarized. Then the need for assigning a consistent meaning to TRIO specifications is discussed, with reference to a variety of underlying time structures such as infinite-time structures (both dense and discrete) and finite-time structures. The main motivation is the ability to validate formal specifications. A solution ...

Keywords: first-order logic, formal specifications, model-theoretic semantics, real-time systems, requirements validation, temporal logic

16 On the efficiency of pairing heaps and related data structures

Michael L. Fredman

July 1999 **Journal of the ACM (JACM)**, Volume 46 Issue 4Full text available:  [pdf\(191.73 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

The pairing heap is well regarded as an efficient data structure for implementing priority queue operations. It is included in the GNU C++ library. Strikingly simple in design, the pairing heap data structure nonetheless seems difficult to analyze, belonging to the genre of self-adjusting data structures. With its design originating as a self-adjusting analogue of the Fibonacci heap, it has been previously conjectured that the pairing heap provides constant amortized time decrease-key ope ...

Keywords: Fibonacci heaps, amortized complexity analysis, lower bounds, priority queues, self-adjusting data structures

17 Session 9A: Fully-dynamic two dimensional orthogonal range and line segmentintersection reporting in logarithmic time

Christian Worm Mortensen

January 2003 **Proceedings of the fourteenth annual ACM-SIAM symposium on Discrete algorithms**Full text available:  [pdf\(1.12 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We consider the two dimensional fully-dynamic orthogonal range reporting problem and the two dimensional fully-dynamic orthogonal line segment intersection reporting problem in the comparison model. We show that if n is the number of stored elements, then these problems can be solved in worst case time $\Theta(\log n)$ plus time proportional to the size of the output pr. operation.

18 Object-based and image-based object representations

Hanen Samet

June 2004 **ACM Computing Surveys (CSUR)**, Volume 36 Issue 2Full text available:  [pdf\(1.05 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

An overview is presented of object-based and image-based representations of objects by their interiors. The representations are distinguished by the manner in which they can be

used to answer two fundamental queries in database applications: (1) Feature query: given an object, determine its constituent cells (i.e., their locations in space). (2) Location query: given a cell (i.e., a location in space), determine the identity of the object (or objects) of which it is a member as well as the re ...

Keywords: Access methods, R-trees, feature query, geographic information systems (GIS), image space, location query, object space, octrees, pyramids, quadtrees, space-filling curves, spatial databases

19 Design of an external schema facility to define and process recursive structures 

Eric K. Clemons

June 1981 **ACM Transactions on Database Systems (TODS)**, Volume 6 Issue 2

Full text available:  [pdf\(1.08 MB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The role of the external schema is to support user views of data and thus to provide programmers with easier data access. This author believes that an external schema facility is best based on hierarchies, both simple and recursive. After a brief introduction to an external schema facility to support simple hierarchical user views, the requirements for a facility for recursive hierarchies are listed and the necessary extensions to the external schema definition language are offered. < ...

Keywords: ANSI SPARC architectures, external schemata, recursive data structures, user views

20 Phylogenetic Networks: Modeling, Reconstructability, and Accuracy 

Bernard M. E. Moret, Luay Nakhleh, Tandy Warnow, C. Randal Linder, Anna Tholse, Anneke Padolina, Jerry Sun, Ruth Timme

January 2004 **IEEE/ACM Transactions on Computational Biology and Bioinformatics (TCBB)**, Volume 1 Issue 1

Full text available:  [pdf\(1.14 MB\)](#) Additional Information: [full citation](#)

Keywords: Index Terms- Phylogenetic networks, reticulate evolution, error metric, Robinson-Foulds, bipartitions, tripartitions.

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1 Effect of node size on the performance of cache-conscious B⁺-trees 

Richard A. Hankins, Jignesh M. Patel
June 2003 **ACM SIGMETRICS Performance Evaluation Review, Proceedings of the 2003 ACM SIGMETRICS international conference on Measurement and modeling of computer systems**, Volume 31 Issue 1

Full text available:  pdf(271.16 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

In main-memory databases, the number of processor cache misses has a critical impact on the performance of the system. Cache-conscious indices are designed to improve performance by reducing the number of processor cache misses that are incurred during a search operation. Conventional wisdom suggests that the index's node size should be equal to the cache line size in order to minimize the number of cache misses and improve performance. As we show in this paper, this design choice ignores additi ...

Keywords: B⁺-tree, cache-conscious, index

2 Performance of B⁺ tree concurrency control algorithms 

V. Srinivasan, Michael J. Carey
October 1993 **The VLDB Journal — The International Journal on Very Large Data Bases**, Volume 2 Issue 4

Full text available:  pdf(2.67 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

A number of algorithms have been proposed to access B⁺-trees concurrently, but they are not well understood. In this article, we study the performance of various B⁺-tree concurrency control algorithms using a detailed simulation model of B⁺-tree operations in a centralized DBMS. Our study covers a wide range of data contention situations and resource conditions. In addition, based on the performance of the set of B⁺-tree concurrency control algorithms, ...

Keywords: B⁺-tree structures, data contention, lock modes, performance, resource conditions, simulation models, workload parameters

3 On zone-balancing of peer-to-peer networks: analysis of random node join 

Xiaoming Wang, Yueping Zhang, Xiafeng Li, Dmitri Loguinov
June 2004 **ACM SIGMETRICS Performance Evaluation Review, Proceedings of the joint international conference on Measurement and modeling of computer systems**, Volume 32 Issue 1

Full text available:  pdf(282.76 KB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Balancing peer-to-peer graphs, including zone-size distributions, has recently become an important topic of peer-to-peer (P2P) research [1], [2], [6], [19], [31], [36]. To bring analytical understanding into the various peer-join mechanisms, we study how zone-balancing decisions made during the initial sampling of the peer space affect the resulting zone sizes and derive several asymptotic results for the maximum and minimum zone sizes that hold with high probability.

Keywords: balls-into-bins, load-balancing, modeling, peer-to-peer

4 [A new representation for linear lists](#)



Leo J. Guibas, Edward M. McCreight, Michael F. Plass, Janet R. Roberts

May 1977 **Proceedings of the ninth annual ACM symposium on Theory of computing**Full text available:  pdf(831.46 KB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We present a new data structure for maintaining a set of records in a linear list according to their key values. This data structure has the property that we can keep a number of fingers at points of interest in the key space (e.g., the beginning or the end of the list), so that access and modification in the neighborhood of a finger is very efficient. In the Section 2 we discuss the general structure of our B-tree. Since we propose to search the tree from a leaf ...

5 [Research sessions: implementation techniques: Fractal prefetching B[±]-Trees: optimizing both cache and disk performance](#)



Shimin Chen, Phillip B. Gibbons, Todd C. Mowry, Gary Valentin

June 2002 **Proceedings of the 2002 ACM SIGMOD international conference on Management of data**Full text available:  pdf(1.49 MB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

B[±]-Trees have been traditionally optimized for I/O performance with disk pages as tree nodes. Recently, researchers have proposed new types of B[±]-Trees optimized for CPU cache performance in main memory environments, where the tree node sizes are one or a few cache lines. Unfortunately, due primarily to this large discrepancy in optimal node sizes, existing disk-optimized B[±]-Trees suffer from poor cache performance while cache-optimized B[±]-Trees exhib ...

6 [Industrial sessions: commercial implementation techniques: A compact B-tree](#)



Peter Bumbulis, Ivan T. Bowman

June 2002 **Proceedings of the 2002 ACM SIGMOD international conference on Management of data**Full text available:  pdf(825.30 KB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

In this paper we describe a Patricia tree-based B-tree variant suitable for OLTP. In this variant, each page of the B-tree contains a local Patricia tree instead of the usual sorted array of keys. It has been implemented in iAnywhere ASA Version 8.0. Preliminary experience has shown that these indexes can provide significant space and performance benefits over existing ASA indexes.

7 [Improving index performance through prefetching](#)



Shimin Chen, Phillip B. Gibbons, Todd C. Mowry

May 2001 **ACM SIGMOD Record , Proceedings of the 2001 ACM SIGMOD international conference on Management of data**, Volume 30 Issue 2

Full text available:  pdf(322.21 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper proposes and evaluate *Prefetching B⁺-Trees* (pB⁺-Trees), which use prefetching to accelerate two important operations on B⁺-Tree indices: searches and range scans. To accelerate searches, pB⁺-Trees use prefetching to effectively create wider nodes than the natural data transfer size: e.g., eight vs. one cache lines or disk pages. These wider nodes reduce the height of the B⁺-Tree, thereby decreasing the number of e ...

8 Physical storage structures: On B-trees: routing schemes and concurrency 

Y. S. Kwong, D. Wood

May 1980 **Proceedings of the 1980 ACM SIGMOD international conference on Management of data**

Full text available:  pdf(532.63 KB) Additional Information: [full citation](#), [abstract](#), [references](#)

In recent years B-trees have become a common data structure for representing large data dictionaries. In this paper we investigate the often ignored relationship between routing schemes and the permissible operations in leaf-search B-trees. We show that among the many commonly used routing schemes in the literature, some are cleaner than others, making them more attractive for leaf-search B-trees supporting concurrency.

9 Fully persistent B⁺-trees 

Sitaram Lanka, Eric Mays

April 1991 **ACM SIGMOD Record , Proceedings of the 1991 ACM SIGMOD international conference on Management of data**, Volume 20 Issue 2

Full text available:  pdf(1.07 MB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

10 Research sessions: compression: Dwarf: shrinking the PetaCube 

Yannis Sismanis, Antonios Deligiannakis, Nick Roussopoulos, Yannis Kotidis

June 2002 **Proceedings of the 2002 ACM SIGMOD international conference on Management of data**

Full text available:  pdf(1.38 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Dwarf is a highly compressed structure for computing, storing, and querying data cubes. Dwarf identifies prefix and suffix structural redundancies and factors them out by coalescing their store. Prefix redundancy is high on dense areas of cubes but suffix redundancy is significantly higher for sparse areas. Putting the two together fuses the exponential sizes of high dimensional full cubes into a dramatically condensed data structure. The elimination of suffix redundancy has an equally dramatic ...

11 An empirical comparison of B-trees, compact B-trees and multiway trees 

David M. Arnow, Aaron M. Tenenbaum

June 1984 **ACM SIGMOD Record , Proceedings of the 1984 ACM SIGMOD international conference on Management of data**, Volume 14 Issue 2

Full text available:  pdf(968.89 KB) Additional Information: [full citation](#), [abstract](#), [references](#)

It is well-known that the B-tree data structure yields excellent worst-case search costs and for that reason is widely employed in the organization of external files and in the implementation of data bases. In this paper, we examine general B-trees empirically and compare them with a less restrictive structure, the general multiway tree, and a more restrictive structure, the compact B-tree. We compare search costs, insertion costs, and space costs of these three structures for both small and lar ...

12 Secure key agreement for group communications 

Wen-Her Yang, Shiu-Pyng Shieh

November 2001 **International Journal of Network Management**, Volume 11 Issue 6

Full text available:  [pdf\(174.68 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

A secure key agreement protocol for group communications is proposed in this paper, which ensures the authenticity of group members and the privacy of group messages, and provides the properties of perfect forward and backward privacy. In a group session, the common key is collaboratively established by all participants, hence the overhead of key agreement is balanced among group members.

13 The LHAM log-structured history data access method



Peter Muth, Patrick O'Neil, Achim Pick, Gerhard Weikum

February 2000 **The VLDB Journal — The International Journal on Very Large Data Bases**, Volume 8 Issue 3-4

Full text available:  [pdf\(494.76 KB\)](#) Additional Information: [full citation](#), [abstract](#), [index terms](#)

Numerous applications such as stock market or medical information systems require that both historical and current data be logically integrated into a temporal database. The underlying access method must support different forms of "time-travel" queries, the migration of old record versions onto inexpensive archive media, and high insertion and update rates. This paper presents an access method for transaction-time temporal data, called the log-structured history data access method (L ...

Keywords: Data warehouses, Index structures, Performance, Storage systems, Temporal databases

14 Efficient concurrency control in multidimensional access methods



Kaushik Chakrabarti, Sharad Mehrotra

June 1999 **ACM SIGMOD Record , Proceedings of the 1999 ACM SIGMOD international conference on Management of data**, Volume 28 Issue 2

Full text available:  [pdf\(1.79 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The importance of multidimensional index structures to numerous emerging database applications is well established. However, before these index structures can be supported as access methods (AMs) in a "commercial-strength" database management system (DBMS), efficient techniques to provide transactional access to data via the index structure must be developed. Concurrent accesses to data via index structures introduce the problem of protecting ranges specified in the retrieval fr ...

15 The design of \neg 1NF relational databases into nested normal form



Mark A. Roth, Henry F. Korth

December 1987 **ACM SIGMOD Record , Proceedings of the 1987 ACM SIGMOD international conference on Management of data**, Volume 16 Issue 3

Full text available:  [pdf\(1.51 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We develop new algorithms for the design of non first normal form relational databases that are in nested normal form. Previously, a set of given multivalued dependencies and those multivalued dependencies implied by given functional dependencies were used to obtain a nested normal form decomposition of a scheme. This method ignored the semantic distinction between functional and multivalued dependencies and utilized only full multivalued dependencies in the design process. We propose new a ...

16 All searches are divided into three parts: string searches using ternary trees



David E. Siegel

July 1998 **ACM SIGAPL APL Quote Quad , Proceedings of the APL98 conference on Array processing language**, Volume 29 Issue 3

Full text available:  [pdf\(702.49 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This paper considers the problem of searching for strings in a dictionary or symbol table. It presents a data structure which can be used for this purpose---the Ternary Tree. It considers the theoretical properties of this structure, compared with other possible structures for the same purpose. It presents an implementation of this structure in APL, including code to do a variety of operations on it.

Keywords: data structure, dictionary search, radix search, search algorithms, search tree, symbol table, ternary tree

17 Concurrency and recovery for index trees

David Lomet, Betty Salzberg

August 1997 **The VLDB Journal — The International Journal on Very Large Data Bases**, Volume 6 Issue 3

Full text available:  [pdf\(168.36 KB\)](#) Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)

Although many suggestions have been made for concurrency in B \$^+\$-trees, few of these have considered recovery as well. We describe an approach which provides high concurrency while preserving well-formed trees across system crashes. Our approach works for a class of index trees that is a generalization of the B \$^{\{\backslash rm link\}}\$-tree. This class includes some multi-attribute indexes and temporal indexes. Structural changes in an index tree are decomposed into a sequence of atomic actions, each one ...

Keywords: Access methods, B-trees, Concurrency, Indexing, Recovery



18 On effective multi-dimensional indexing for strings

H. V. Jagadish, Nick Koudas, Divesh Srivastava

May 2000 **ACM SIGMOD Record , Proceedings of the 2000 ACM SIGMOD international conference on Management of data**, Volume 29 Issue 2

Full text available:  [pdf\(1.15 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

As databases have expanded in scope from storing purely business data to include XML documents, product catalogs, e-mail messages, and directory data, it has become increasingly important to search databases based on wild-card string matching: prefix matching, for example, is more common (and useful) than exact matching, for such data. In many cases, matches need to be on multiple attributes/dimensions, with correlations between the dimensions. Traditional multi-dimensional index structures, ...



19 Speeding up construction of PMR quadtree-based spatial indexes

Gisli R. Hjaltason, Hanan Samet

October 2002 **The VLDB Journal — The International Journal on Very Large Data Bases**, Volume 11 Issue 2

Full text available:  [pdf\(355.72 KB\)](#) Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)



Spatial indexes, such as those based on the quadtree, are important in spatial databases for efficient execution of queries involving spatial constraints, especially when the queries involve spatial joins. In this paper we present a number of techniques for speeding up the construction of quadtree-based spatial indexes, specifically the PMR quadtree, which can index arbitrary spatial data. We assume a quadtree implementation using the "linear quadtree", a disk-resident representation ...

Keywords: Bulk-loading, I/O, Spatial indexing

20 Spatial indexing of high-dimensional data based on relative approximation 

Yasushi Sakurai, Masatoshi Yoshikawa, Shunsuke Uemura, Haruhiko Kojima

October 2002 **The VLDB Journal — The International Journal on Very Large Data Bases**,
Volume 11 Issue 2Full text available:  [pdf\(216.44 KB\)](#) Additional Information: [full citation](#), [abstract](#), [index terms](#)

We propose a novel index structure, the A-tree (approximation tree), for similarity searches in high-dimensional data. The basic idea of the A-tree is the introduction of virtual bounding rectangles (VBRs) which contain and approximate MBRs or data objects. VBRs can be represented quite compactly and thus affect the tree configuration both quantitatively and qualitatively. First, since tree nodes can contain a large number of VBR entries, fanout becomes large, which increases search speed. More ...

Keywords: High-dimensional data, Relative approximation, Similarity search

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Relevance scale **1 [Effect of node size on the performance of cache-conscious B⁺-trees](#)**

Richard A. Hankins, Jignesh M. Patel

June 2003 **ACM SIGMETRICS Performance Evaluation Review , Proceedings of the 2003 ACM SIGMETRICS international conference on Measurement and modeling of computer systems**, Volume 31 Issue 1Full text available:  [pdf\(271.16 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

In main-memory databases, the number of processor cache misses has a critical impact on the performance of the system. Cache-conscious indices are designed to improve performance by reducing the number of processor cache misses that are incurred during a search operation. Conventional wisdom suggests that the index's node size should be equal to the cache line size in order to minimize the number of cache misses and improve performance. As we show in this paper, this design choice ignores additi ...

Keywords: B⁺-tree, cache-conscious, index**2 [Making B⁺- trees cache conscious in main memory](#)**

Jun Rao, Kenneth A. Ross

May 2000 **ACM SIGMOD Record , Proceedings of the 2000 ACM SIGMOD international conference on Management of data**, Volume 29 Issue 2Full text available:  [pdf\(406.75 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Previous research has shown that cache behavior is important for main memory index structures. Cache conscious index structures such as Cache Sensitive Search Trees (CSS-Trees) perform lookups much faster than binary search and T-Trees. However, CSS-Trees are designed for decision support workloads with relatively static data. Although B⁺-Trees are more cache conscious than binary search and T-Trees, their utilization of a cache line is low since half of the space is used to store ...

3 [Concurrency and recovery for index trees](#)

David Lomet, Betty Sälzberg

August 1997 **The VLDB Journal — The International Journal on Very Large Data Bases**, Volume 6 Issue 3Full text available:  [pdf\(168.36 KB\)](#) Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)

Although many suggestions have been made for concurrency in B⁺-trees, few of these have considered recovery as well. We describe an approach which provides high

concurrency while preserving well-formed trees across system crashes. Our approach works for a class of index trees that is a generalization of the B $\wedge \{\backslash \text{rm link}\}$ -tree. This class includes some multi-attribute indexes and temporal indexes. Structural changes in an index tree are decomposed into a sequence of atomic actions, each one ...

Keywords: Access methods, B-trees, Concurrency, Indexing, Recovery

4 Group updates for relaxed height-balanced trees 

Lauri Malmi, Eljas Soisalon-Soininen

May 1999 **Proceedings of the eighteenth ACM SIGMOD-SIGACT-SIGART symposium on Principles of database systems**

Full text available:  pdf(1.19 MB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

5 Improving index performance through prefetching 

Shimin Chen, Phillip B. Gibbons, Todd C. Mowry

May 2001 **ACM SIGMOD Record , Proceedings of the 2001 ACM SIGMOD international conference on Management of data**, Volume 30 Issue 2

Full text available:  pdf(322.21 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper proposes and evaluate *Prefetching B⁺-Trees* (pB⁺-Trees), which use prefetching to accelerate two important operations on B⁺-Tree indices: searches and range scans. To accelerate searches, pB⁺-Trees use prefetching to effectively create wider nodes than the natural data transfer size: e.g., eight vs. one cache lines or disk pages. These wider nodes reduce the height of the B⁺-Tree, thereby decreasing the number of e ...

6 A symmetric concurrent B-tree algorithm 

Vladimir Lanin, Dennis Shasha

November 1986 **Proceedings of 1986 ACM Fall joint computer conference**

Full text available:  pdf(1.10 MB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

7 The string B-tree: a new data structure for string search in external memory and its applications 

Paolo Ferragina, Roberto Grossi

March 1999 **Journal of the ACM (JACM)**, Volume 46 Issue 2

Full text available:  pdf(363.37 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We introduce a new text-indexing data structure, the String B-Tree, that can be seen as a link between some traditional external-memory and string-matching data structures. In a short phrase, it is a combination of B-trees and Patricia tries for internal-node indices that is made more effective by adding extra pointers to speed up search and update operations. Consequently, the String B-Tree overcomes the theoretical limitations of inverted files, B-trees, prefix B-trees, s ...

Keywords: B-tree, Patricia trie, external-memory data structure, prefix and range search, string searching and sorting, suffix array, suffix tree, text index

8 Industrial sessions: commercial implementation techniques: A compact B-tree 

Peter Bumbulis, Ivan T. Bowman

June 2002 **Proceedings of the 2002 ACM SIGMOD international conference on Management of data**

Full text available:  [pdf\(825.30 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

In this paper we describe a Patricia tree-based B-tree variant suitable for OLTP. In this variant, each page of the B-tree contains a local Patricia tree instead of the usual sorted array of keys. It has been implemented in iAnywhere ASA Version 8.0. Preliminary experience has shown that these indexes can provide significant space and performance benefits over existing ASA indexes.

9 Comparison of access methods for time-evolving data 

Betty Salzberg, Vassilis J. Tsotras

June 1999 **ACM Computing Surveys (CSUR)**, Volume 31 Issue 2

Full text available:  [pdf\(529.53 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper compares different indexing techniques proposed for supporting efficient access to temporal data. The comparison is based on a collection of important performance criteria, including the space consumed, update processing, and query time for representative queries. The comparison is based on worst-case analysis, hence no assumptions on data distribution or query frequencies are made. When a number of methods have the same asymptotic worst-case behavior, features in the methods tha ...

Keywords: I/O performance, access methods, structures, temporal databases

10 Research sessions: implementation techniques: Fractal prefetching B[±]-Trees: optimizing both cache and disk performance 

Shimin Chen, Phillip B. Gibbons, Todd C. Mowry, Gary Valentin

June 2002 **Proceedings of the 2002 ACM SIGMOD international conference on Management of data**

Full text available:  [pdf\(1.49 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

B[±]-Trees have been traditionally optimized for I/O performance with disk pages as tree nodes. Recently, researchers have proposed new types of B[±]-Trees optimized for CPU cache performance in main memory environments, where the tree node sizes are one or a few cache lines. Unfortunately, due primarily to this large discrepancy in optimal node sizes, existing disk-optimized B[±]-Trees suffer from poor cache performance while cache-optimized B[±]-Trees exhibi ...

11 Burst tries: a fast, efficient data structure for string keys 

April 2002 **ACM Transactions on Information Systems (TOIS)**, Volume 20 Issue 2

Full text available:  [pdf\(324.84 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

Many applications depend on efficient management of large sets of distinct strings in memory. For example, during index construction for text databases a record is held for each distinct word in the text, containing the word itself and information such as counters. We propose a new data structure, the burst trie, that has significant advantages over existing options for such applications: it uses about the same memory as a binary search tree; it is as fast as a trie; and, while not as fast as a ...

Keywords: Binary trees, splay trees, string data structures, text databases, tries, vocabulary accumulation

12 Pipelining with futures

Guy E. Blelloch, Margaret Reid-Miller

June 1997 **Proceedings of the ninth annual ACM symposium on Parallel algorithms and architectures**Full text available:  pdf(1.73 MB)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)**13 Concurrency and recovery in generalized search trees**

Marcel Kornacker, C. Mohan, Joseph M. Hellerstein

June 1997 **ACM SIGMOD Record , Proceedings of the 1997 ACM SIGMOD international conference on Management of data**, Volume 26 Issue 2Full text available:  pdf(1.59 MB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper presents general algorithms for concurrency control in tree-based access methods as well as a recovery protocol and a mechanism for ensuring repeatable read. The algorithms are developed in the context of the Generalized Search Tree (GiST) data structure, an index structure supporting an extensible set of queries and data types.

Although developed in a GiST context, the algorithms are generally applicable to many tree-based access methods. The concurrency control protocol is base ...

14 The performance of current B-tree algorithms

Theodore Johnson, Dennis Sasha

March 1993 **ACM Transactions on Database Systems (TODS)**, Volume 18 Issue 1Full text available:  pdf(2.87 MB)Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#), [review](#)

Keywords: B-trees, concurrent B-trees, concurrent data structures, performance of concurrent algorithms

15 P-trees: storage efficient multiway trees

David M. Arnow, Aaron M. Tenenbaum, Connie Wu

June 1985 **Proceedings of the 8th annual international ACM SIGIR conference on Research and development in information retrieval**Full text available:  pdf(471.02 KB)Additional Information: [full citation](#), [abstract](#), [references](#)

A new variation of high order multiway tree structures, the P-tree is presented. P-trees have average access costs that are significantly better than those of B-trees and are no worse (and often better) in storage utilization. Unlike compact B-trees, they can be maintained dynamically, and unlike dense multiway trees and B-trees, their associated insertion algorithm, which is also presented, is cheap and involves (at most) a very localized rearrangement of keys.

16 Main-memory index structures with fixed-size partial keys

Philip Bohannon, Peter McIlroy, Rajeev Rastogi

May 2001 **ACM SIGMOD Record , Proceedings of the 2001 ACM SIGMOD international conference on Management of data**, Volume 30 Issue 2Full text available:  pdf(185.51 KB)Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The performance of main-memory index structures is increasingly determined by the number of CPU cache misses incurred when traversing the index. When keys are stored indirectly, as is standard in main-memory databases, the cost of key retrieval in terms of cache misses can dominate the cost of an index traversal. Yet it is inefficient in both time

and space to store even moderate sized keys directly in index nodes. In this paper, we investigate the performance of tree structures suitable for ...

Keywords: B-trees, T-tree, cache coherence, key compression, main-memory indices

17 Optimizing multidimensional index trees for main memory access 

Kihong Kim, Sang K. Cha, Keunwoo Kwon

May 2001 **ACM SIGMOD Record , Proceedings of the 2001 ACM SIGMOD international conference on Management of data**, Volume 30 Issue 2

Full text available:  pdf(243.75 KB)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Recent studies have shown that cache-conscious indexes such as the CSB+-tree outperform conventional main memory indexes such as the T-tree. The key idea of these cache-conscious indexes is to eliminate most of child pointers from a node to increase the fanout of the tree. When the node size is chosen in the order of the cache block size, this pointer elimination effectively reduces the tree height, and thus improves the cache behavior of the index. However, the pointer elimination cannot be ...

18 Algorithms and data structures: Concurrent cache-oblivious b-trees 

Michael A. Bender, Jeremy T. Fineman, Seth Gilbert, Bradley C. Kuszmaul

July 2005 **Proceedings of the 17th annual ACM symposium on Parallelism in algorithms and architectures SPAA'05**

Full text available:  pdf(180.51 KB)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This paper presents concurrent cache-oblivious (CO) B-trees. We extend the cache-oblivious model to a parallel or distributed setting and present three concurrent CO B-trees. Our first data structure is a concurrent lock-based exponential CO B-tree. This data structure supports insertions and non-blocking searches/successor queries. The second and third data structures are lock-based and lock-free variations, respectively, on the packed-memory CO B-tree. These data structures support range queri ...

Keywords: cache-oblivious b-tree, concurrent b-tree, exponential tree, lock free, non-blocking, packed-memory array

19 Uncoupling updating and rebalancing in chromatic binary search trees 

Otto Nurmi, Eljas Soisalon-Soininen

April 1991 **Proceedings of the tenth ACM SIGACT-SIGMOD-SIGART symposium on Principles of database systems**

Full text available:  pdf(724.54 KB)

Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

20 The hB-tree: a multiattribute indexing method with good guaranteed performance 

David B. Lomet, Betty Salzberg

December 1990 **ACM Transactions on Database Systems (TODS)**, Volume 15 Issue 4

Full text available:  pdf(2.58 MB)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#), [review](#)

A new multiattribute index structure called the hB-tree is introduced. It is derived from the K-D-B-tree of Robinson [15] but has additional desirable properties. The hB-tree internode search and growth processes are precisely analogous to the corresponding processes in B-trees [1]. The intranode processes are unique. A k-d tree is used as the structure within nodes for very efficient searching. Node splitting requires that this k-d tree be split. This produces nodes which no longer represe ...

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Collect all the **node**-parents and their parents up to **root node** or **nodes**. **Node** self is also ... generic procedure: **node-next-hierarchy** `self::node => node` ...

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[PDF] Efficient Tree Layout in a Multilevel Memory Hierarchy

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problem for a multilevel memory **hierarchy**. The query performance of ... **node** w is stored in the **root** block (but by **definition** is not in the **root-block** ...

theory.csail.mit.edu/~edemaine/papers/TreeLayout_ESA2002/paper.pdf - [Similar pages](#)

2a. Displaying a DOM Hierarchy

Next, **define** the **AdapterNode** wrapper for **DOM nodes**: ... In this code, the **getRoot** method returns the **root node** of the **DOM**, wrapped as an **AdapterNode** object. ...

java.sun.com/xml/jaxp/dist/1.1/docs/tutorial/dom/2_display.html - 40k - [Cached](#) - [Similar pages](#)

Jetspeed-2 Security Components - Jetspeed 2 Security - Hierarchy ...

... `<map /> <node name="roleid1.1.1"> <map /> </node> </node> </node> </root>`.

This structure would **define** the following group and role **hierarchy**: ...

portals.apache.org/jetspeed-2/multiproject/jetspeed-security/hierarchy.html - 12k - Sep 26, 2005 - [Cached](#) - [Similar pages](#)

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Logical and Constraint Based Browse **Hierarchy** with Propagation Features ... are related to one another in a tree-like structure starting with a **root node**. ...

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[PS] CS174b Computer Graphics Bounding Hierarchies Bounding Hierarchies ...

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... area of **root node**), it can be removed from the cost calculation. ... We also define the cost of a **leaf node** in the **hierarchy** to be zero since it has no ...

www.g.cs.caltech.edu/~cs174ta/Winter/Homework/Homework2/boundingHierarchy.ps - [Similar pages](#)

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Understanding extension **nodes** · Specific implementations of extension **nodes** and extension **node adapters** ... Appendix A. Managing **root** volume groups ...

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Using Yads. Yads is a complex system, and it is not easy to use. Unless your application is really trivial, you to define the multi-node document hierarchy, and to change the default output ... attribute of your root element www.twostones.org/soft/yads/using.html - 23k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

2. http://www.csd.uwo.ca/~lynda/CS027/2005Jan/ch12_trees.ppt (MICROSOFT POWERPOINT)

... define trees as data structures. define the terms associated with ... or predecessor: the node directly above ... www.csd.uwo.ca/~lynda/CS027/2005Jan/ch12_trees.ppt - 847k - [View as html](#) - [More from this site](#) - [Save](#) - [Block](#)

3. <http://www.tcnj.edu/~mmmmartin/CSC230/Slides/ppt09.ppt> (MICROSOFT POWERPOINT)

... Define trees as data structures. Define the terms associated ... in which elements are organized into a tree. www.tcnj.edu/~mmmmartin/CSC230/Slides/ppt09.ppt - 959k - [View as html](#) - [More from this site](#) - [Save](#) - [Block](#)

4. http://www.cclabs.missouri.edu/things/instruction/aw/ReleaseNotes/06_anim.notes.html

Animation Notes. General Animation Notes. Limitation: Animation Turntable does not rotate about the origin with hierarchy set to BELOW. ... its inertia tensor, which also happens to define the object's principal axes. www.cclabs.missouri.edu/things/.../aw/ReleaseNotes/06_anim.notes.html - 61k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

5. **Goops Manual**

... Node:Class hierarchy and inheritance of slots, Next:Instance creation and ... <object>, the root of all objects. [www.gnu.org/software/.../Class-hierarchy-and-inheritance-of-slots.html](http://gnu.org/software/.../Class-hierarchy-and-inheritance-of-slots.html) - 2k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

6. **VDS_64_BITS**

... Define VDS_64_BITS for 64-bit node paths. A vdsNodePath is a bit vector encapsulating the path from a node. [www.vdslib.virginia.edu/vdsdoc/VDS_64_BITS.html](http://vdslib.virginia.edu/vdsdoc/VDS_64_BITS.html) - 2k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

7. **UNIDO**

UNIDO had the need to support "multiple chapter documents". These have some content themselves, this is a chapter document. ... A tree starts with a root node (the document which is at hierarchy level 1). So it might be a good idea to use a tree structure. www.unido.org/doc/doc/user-hierarchy - 39k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

8. **Class Hierarchy Viewer**

The Class Hierarchy Viewer. The class hierarchy viewer is the viewer that you will be in by default when browsing starts at the root of the class hierarchy. This can be ... may assign a node style to a new group. www.ai.sri.com/~gkb/hierarchy.html - 30k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

9. **Network Security and Architecture Laboratory**

bfs.cc File Reference. Include dependency graph for bfs.cc: Defines. Functions. Variables. Define Documentation. BFS. const NodeVec_t & N, ... www.ece.gatech.edu/research/labs/nsa/gtnets/html/bfs_8cc.shtml - 39k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

10. **Control API for Tree View (treeView)**

Control API for Tree View (treeView) A representation of hierarchical data (for example, directory and file) is a tree. The tree is defined by the treeNodes attribute. ... Defines the root node of tree. This attribute is used when the tree is created. www.sapdesignguild.org/resources/htmlb_guidance/treeview_dev.html - 27k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)

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2. [Chapter 3. Nodes and Node Types](#) Chapter 3. Nodes and Node Types. Chapter 3. Nodes and Node Types. A scene graph holds the data of coordinate system contained within it. **Nodes A, B, and C** are the **leaf** geometry **nodes** ... www.cs.rochester.edu/u/wyi/sgi/ch03.html - 86k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)
3. [Scene Graph Basics](#) The Java 3D API Specification. C H A P T E R 3. Scene Graph Basics. A scene graph consists of Java 3D objects that attach them to a virtual universe. ... **node** object, along the path from the **root** to the **leaf**, that changes java.sun.com/products/java-media/.../j3dguide/SceneGraphOverview.html - 28k - [Cached](#) - [More from this site](#)
4. [SGI TPL \(IRIX 6.5: Developer/Perf_PG - Chapter 3. Nodes and Node Types\)](#) ... and **position** it in ... **root node** of the instanced object, and D is a dynamic coordinate system containing ... techpubs.sgi.com/library/tpl/cgi-bin/getdoc.cgi?.../Perf_PG/ch03.html - 103k - [Cached](#) - [More from this site](#)
5. [TopXML : XML in a Nutshell - XPath](#) ... XPath indicates **nodes** by **position**, relative **position**, type, content, and ... **nodes** contain other **node**s: www.topxml.com/xsl/articles/xpath?printerversion=true - 62k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)
6. <http://pdos.csail.mit.edu/6.824/handouts/l19.txt> cell phone numbers a value is a phone's current location Basic idea Two layers: routing (lookup) and data ... **node** ID assignment 2. Define per-node routing table ... c Every **node** acts as a **root**, so there's no root pdos.csail.mit.edu/6.824/handouts/l19.txt - 6k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)
7. <http://pdos.csail.mit.edu/6.824-2001/lecnotes/l20.txt> key X goes on **node** node with nearest ID to X Now how, given X, do we find that **node**? Arrange **nodes** acts as a **root**, so there's no **root** ... tables to reflect new **node**. Other **nodes**' **leaf** sets are ... pdos.csail.mit.edu/6.824-2001/lecnotes/l20.txt - 9k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)
8. <http://www.apl.jhu.edu/Classes/605202/felikson/lectures/L6/L6.html> ... **leaf** or. an internal **node** (the **root** of the tree) and ... Define: h = height. n = # **nodes**. ni ... been deleted www.apl.jhu.edu/Classes/605202/felikson/lectures/L6/L6.html - 33k - [Cached](#) - [More from this site](#) - [Save](#)
9. [Dukas User's Guide: 2.1 Building a Heirarchical Task Tree](#) ... be difficult to **define** the meaning of ... a subtree, **position** the cursor over the **root** of the ... The **root** n www.cc.gatech.edu/gvu/ui/Mastermind/Dukas/doc/ug2.1.html - 5k - [Cached](#) - [More from this site](#) - [Save](#)
10. <http://longwood.cs.ucf.edu/courses/cop3502/fall04/trees1.doc> (MICROSOFT WORD) ... pointers to **define** a non-linear ... at any **position** of the game ... **Nodes** having no children are called **leaves** longwood.cs.ucf.edu/courses/cop3502/fall04/trees1.doc - 115k - [View as html](#) - [More from this site](#) - [Save](#)

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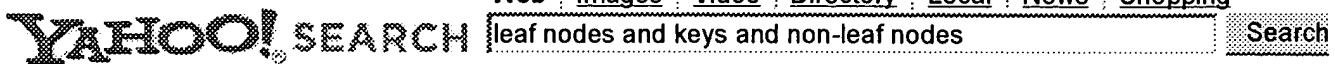
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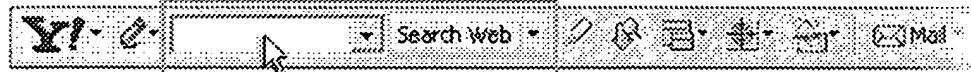
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